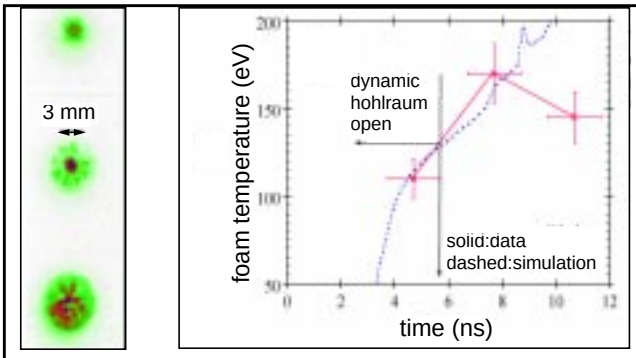
# *December 1997 Highlights of the Pulsed Power Inertial Confinement Fusion Program*




X-ray images along axis on shot 113, taken 3 ns apart, of imploding plasma formed from tungsten wires striking gold-coated TPX foam cylinder. To right is a comparison of the foam temperature vs time with results from a 2-D, r-z MHD calculation by Los Alamos. Deviation from data at late time is from 3-D effects not modeled. Nine-fold filamentary features correlate with the slotted structure of the return current can surrounding the foam cylinder and the resultant B field.

The December *IndustryWeek* announced that the z-pinch program is one of 25 Technologies of the Year. We had 14 shots on Z before shutting down the facility on December 24 for the holidays: two calibration shots after rebuild of the vacuum insulator stack, a shot to test new hardware for wiring nested arrays, two nested-array shots, two aluminum-wire shots, an on-axis dynamic hohlraum shot, a shot to assess whether ion-beam treatment of the cathode and anode could control electron emission at the high currents on X-1, and five shots to measure voltage and current in the pulse-forming, vacuum insulator, and load sections.

Voltage and current monitors are now accurate to the sub-percent level at the vacuum insulator. However, the high radiation levels do not presently allow accurate measurements within 5 cm of the z-pinch load. Recent recalibration at the Brookhaven synchrotron source of x-ray diodes (XRDs) and filters used on ~100 shots indicates that the calibrations changed, over eight months of use, by 30% or more in some spectral regions. The intense radiation environment is the culprit here, too. In the future, we will recycle XRDs periodically and develop the capability to recalibrate them, every 20 shots or so, using local sources.

Modernizing the experimental infrastructure of Z will enhance use of the facility for weapon science and ICF experiments. A weak link in the pulsed power is the existing water transmission lines. Most of the pulsed-power components were designed 15 years ago to generate an electric pulse to drive ion diodes rather than z pinches. Mechanical components in the pulse-forming and transmission-line sections will be replaced to enable reliable operation at increased voltage or pulse width. As part of this process, January maintenance will include replacing some aluminum transmission lines in the water section with stainless steel. The nine transmission lines in the level just below the accelerator center suffer the most damage, so these are being replaced first. Others will be replaced as funding and time permit.

Los Alamos did 2-D magnetohydrodynamic (MHD) simulations of an early phase in the formation of a dynamic hohlraum on Z. Calculated x-ray power and foam temperature vs time as an imploding tungsten plasma stagnates onto a foam cylinder and onto a gold-coated foam cylinder agree with data from shots 112 and 113 (see figure).

Complex loads such as tailored radial or axial density profiles, quasi-spherical loads, or embedded magnetic fields have been proposed to increase the x-ray power and hence the temperatures in dynamic and vacuum hohlraums. For one type of load, a nested wire array, four complementary soft x-ray diagnostics this month measured a radiated x-ray power of 250±50 TW, 25% higher than with a single tungsten array. MHD simulations at Sandia and Los Alamos suggest that nested arrays can reduce the initial Rayleigh-Taylor perturbations of the plasma. We have begun to optimize the performance of nested annular wire arrays on Z, beginning with a 4-cm-diameter, 240-wire outer array of tungsten and a 2-cm-diameter, 120-wire inner one.

Sandia had the lead role in stress and buckling analysis, evaluation of fabrication methods, and preparation of procurement specifications for the NIF target chamber. We are serving as the technical interface to the contractor, Pitt-DesMoines (PDM), during construction. The 10-m-diameter spherical chamber will have 10-cm-thick aluminum walls and over 200 optical and diagnostic ports. The walls, formed from 18 aluminum plates, are to be combined as on a soccer ball surface. Precision Components Corporation will construct the ~300-cm x 900-cm plates, Euroform of Lyon, France will shape them into spherical segments, and PDM will assemble and weld them across the street from the NIF site. The finished sphere will be installed in the laser bay target building before the roof is added.

Contact: Jeff Quintenz, Inertial Confinement Fusion Program, Dept. 9502, 505-845-7245, fax: 505-845-7464, email: jpquint@sandia.gov.
*Highlights* are prepared by Mary Ann Sweeney, Dept. 9502, 505-845-7307, fax: 505-845-7890, email: masween@sandia.gov.
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